

*Agencies on Nutrition Action
New Zealand
May, 2015*



Baker IDI
HEART & DIABETES INSTITUTE

Too Much Sitting: Implications for Chronic Disease Prevention

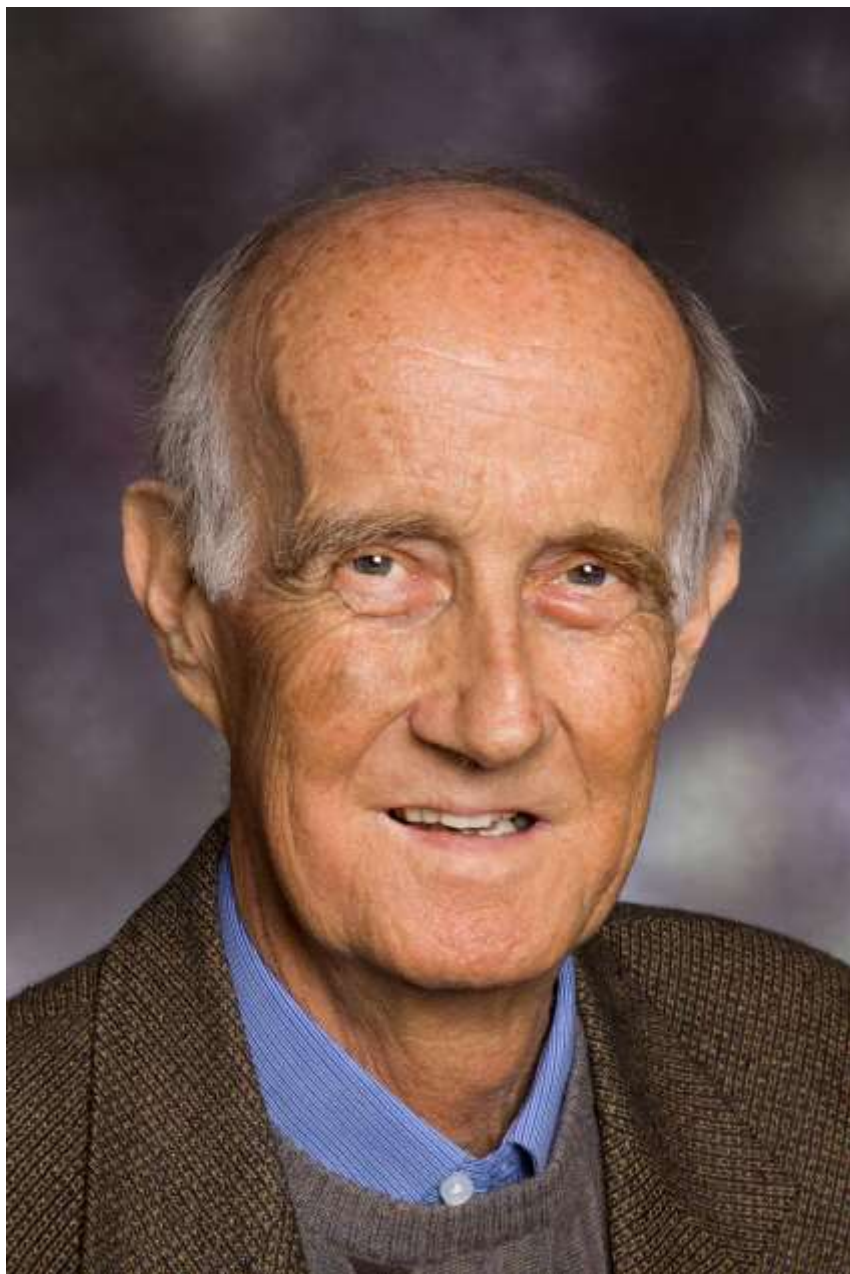
Neville Owen

***NHMRC Senior Principal Research Fellow
Program Head – Behavioural & Generational Change
Baker IDI Heart and Diabetes Institute
neville.owen@bakeridi.edu.au***

***Mauruuru e koe mo te aniraa
atawhai ki te whakauru koe, mo
tou manaaki, me te mo te hanga i
ahau ite na***

*Thank you for the kind invitation to join you, for your
hospitality and for making me feel so welcome*

Thanks to the *HPA* for their support of my visit



Tony McMichael
3 October 1942
26 September 2014

Acknowledgements and thanks

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Particular thanks to:



Jim Sallis



Adrian Bauman



Jo Salmon



Bronwyn Kingwell



David Dunstan



Elizabeth Eakin



Genevieve Healy

Outline – a public health and scientific story in six parts

A pessimistic preamble – the ‘real’ neoliberal-economic world of public health vision-loss, distorted scientific priorities, a bad food supply and stolen opportunities for physical activity

Too little exercise and too much sitting – the evidence and the rapid uptake of the idea

Too much sitting: the epidemiological observational study evidence – anchoring the bottom of the physical activity spectrum; adverse associations for sitting, even among those who exercise

Device-based measurement – new and sobering perspectives on real life activity; breaking up sitting time

Experimental evidence – strengthening causal inference; feasibility and benefits of change

Where to next?

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Where to next?

What has changed in the past 35 years?

(thanks, Kerin O'Dea)

The food supply and eating patterns

Industrialised, global food supply

free trade agreements, the WTO

Portion sizes ↑

Availability of highly processed energy dense foods and drinks

↓ **often low in protein**

Much lower consumption of minimally-processed whole foods

↓ **particularly less fibre-rich plant foods and foods rich in omega-3 fats**

The built environment, inactivity and reduced energy expenditure

- ↑ sitting
- ↓ opportunities for exercise
- central heating
- urbanised living

Reasons to be pessimistic

- ***Big Food and Beverage*** – sugar denialism and other misleading PR tactics; over-promotion of physical activity and ‘energy balance’; little snippets of happiness; and, more (recall the tactics of ***Big Tobacco*** in promoting ‘individual responsibility’ while targeting children and the most vulnerable)
- ***Big oil, automobile, media, entertainment and other industries*** – car dependency, poor investment in public and active transport; physically passive commuting, working, recreation and entertainment
- ***Big Pharma*** – search for new mechanistic targets; the promises of epigenetics; anti-obesity and exercise-mimetic drugs; focus on secondary prevention



DO NOT ROCK

DO NOT REACH
INTO THE MACHINEDO NOT CLIMB
ON VENDERDO NOT PLACE
OBJECTS ON TOPONLY MOVE IN
ACCORDANCE
WITH INSTRUCTIONSKILOJOULES
COUNTFor other great brands and pack sizes not shown here please
visit www.coca-colajourney.com.au or scan QR code

	Average	% Daily	% Daily
Coca-Cola	800mL 1500kJ	100%	100%
Coke Zero	800mL 800kJ	67%	67%
Diet Coke	800mL 800kJ	67%	67%
Fanta Orange	800mL 1180kJ	133%	133%
Li	800mL 1180kJ	133%	133%
Sprite	800mL 1060kJ	127%	127%
Powerade	800mL 770kJ	89%	89%
Glacéau Vitaminwater Range	500mL 360kJ	43%	43%
Goulburn Valley Quencher Range	420mL 580kJ	67%	67%
Goulburn Valley Juice Range	350mL 620kJ	77%	77%
Mother Flavours	500mL 870kJ	111%	111%
Mother Sugar Free	500mL 850kJ	110%	110%
Mount Franklin	800mL 80kJ	0%	0%
Barista Bros	500mL 1810kJ	178%	178%
PUMP	750mL 80kJ	0%	0%

Coca-Cola

* % Daily Intake based on an average daily adult energy intake of 8,700kJ. Not all variants may be available.

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& KILOJOULES*
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sweetness
of steviaQuickTap.com.au
JOIN FOR DISCOUNTS & REWARDS
QUICK AND EASY PAYMENT



SALT

Sugar

FAT

• How the •
FOOD GIANTS
Hooked Us

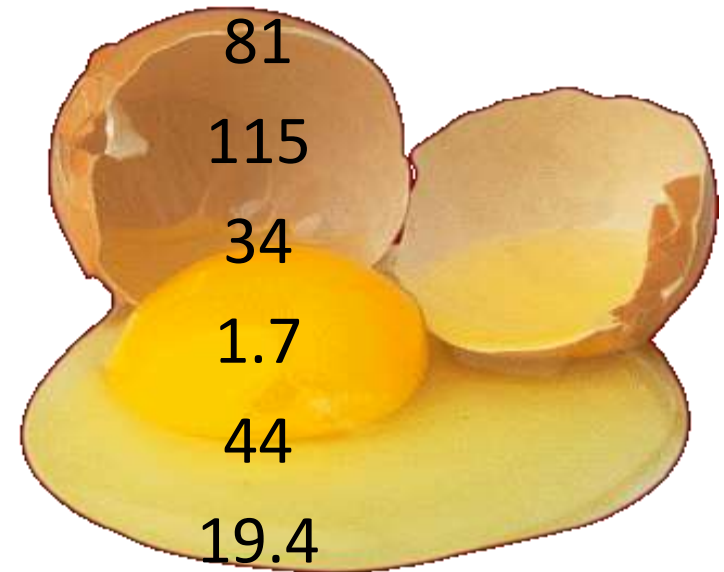
MICHAEL MOSS





Comparison of eggs from a Greek village and a US supermarket (thanks, Kerin O'Dea)

Fatty acid	Greek	Supermarket
Saturated	101	81
MUFA	143	115
n-6PUFA	23	34
n-3PUFA	18	1.7
% saturated	40	44
n-6/n-3	1.3	19.4

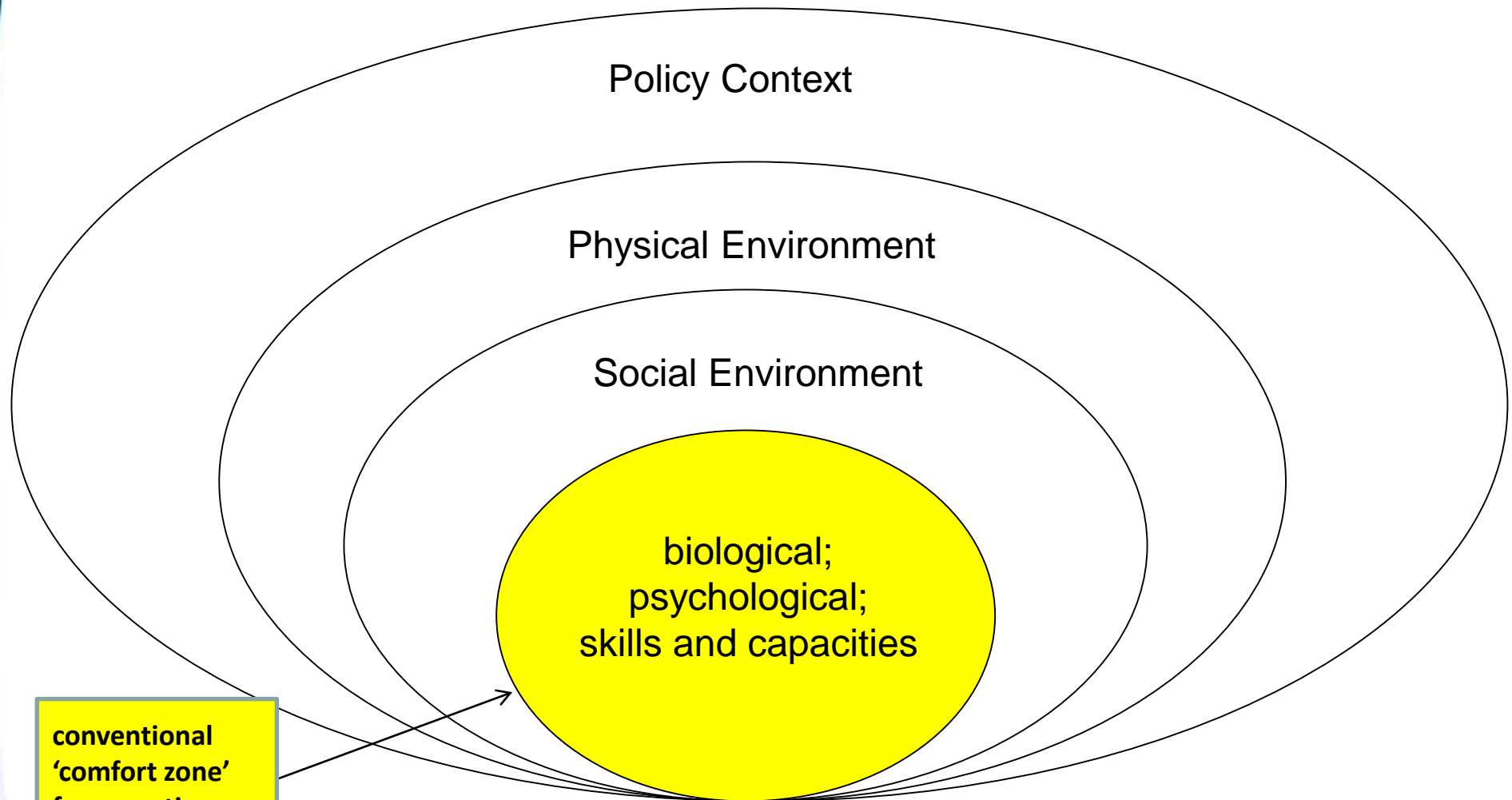


- **Prioritize prevention**
- **Regulate industry**
- **Alter the built environment**



In this context, high-quality evidence is crucial to identify environmental, economic and social influences, who is most at risk, relevant mechanisms, and feasibility and benefits of change

A simplified ecological model of sedentary behaviours



**conventional
'comfort zone'
for causation
and motivation**

Owen, N., Sugiyama, T., Eakin, E.G., Gardiner, P.A., Tremblay, M.S. and Sallis JF. (2011). Adults' sedentary behavior: Determinants and interventions. *American Journal of Preventive Medicine*, 41, 189-196.

Outline

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Where to next?

‘Life is like riding a bicycle. To keep your balance, you must keep moving’



Health benefits of regular physical activity

Strong Evidence:

- ✓ Lower risk of early death
- ✓ Lower risk of CHD
- ✓ Lower risk of stroke
- ✓ Lower risk of high blood pressure
- ✓ Lower risk of adverse blood lipid profile
- ✓ Lower risk of type 2 diabetes
- ✓ Lower risk of the metabolic syndrome
- ✓ Lower risk of colon/breast cancer
- ✓ Weight loss, prevention of weight gain
- ✓ Improved cardio-respiratory and muscular fitness
- ✓ Prevention of falls
- ✓ Reduced depression
- ✓ Better cognitive function



2008 Physical Activity Guidelines for Americans



Be Active, Healthy, and Happy!

www.health.gov/paguidelines



Our world has changed

Then

Now

Transport



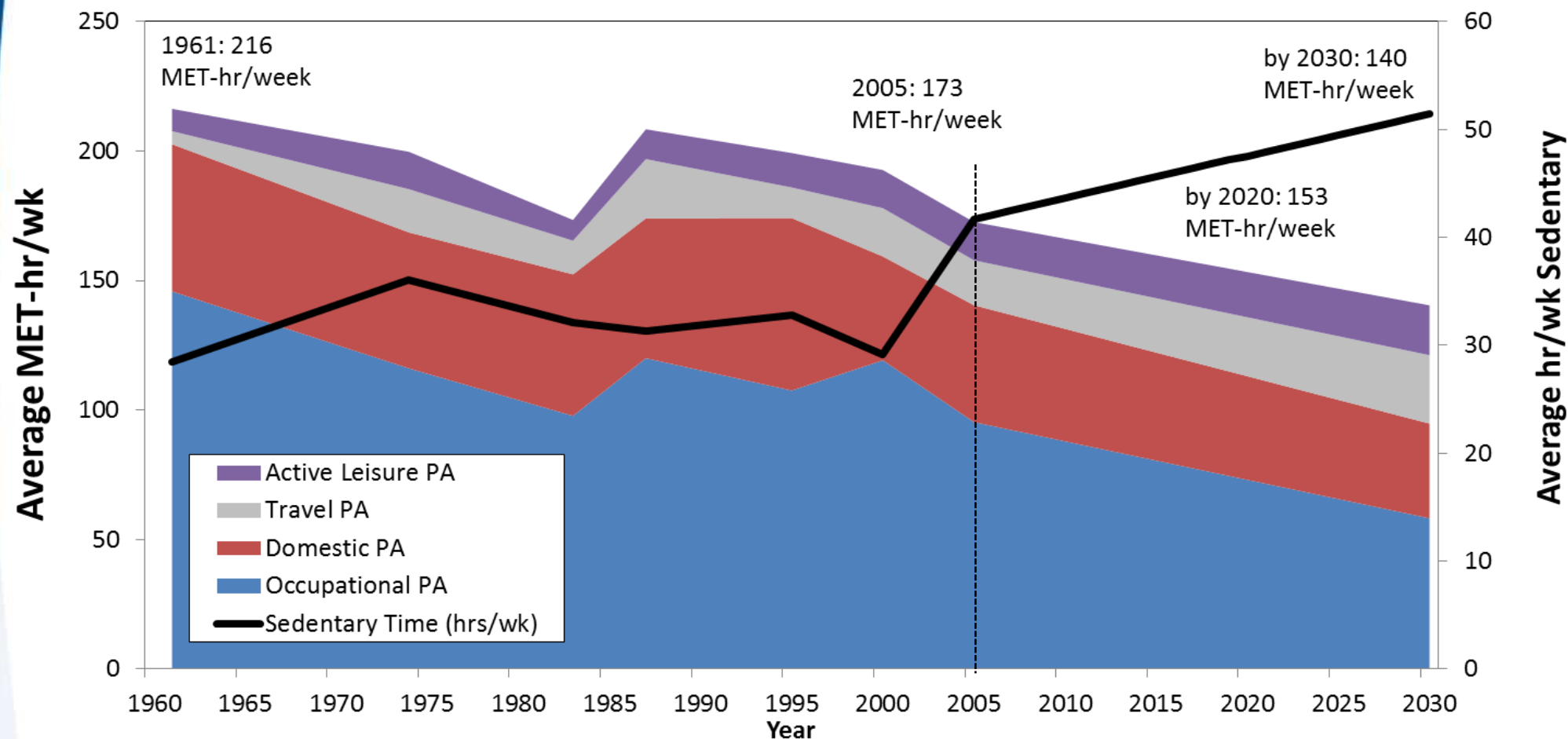
Domestic



Work

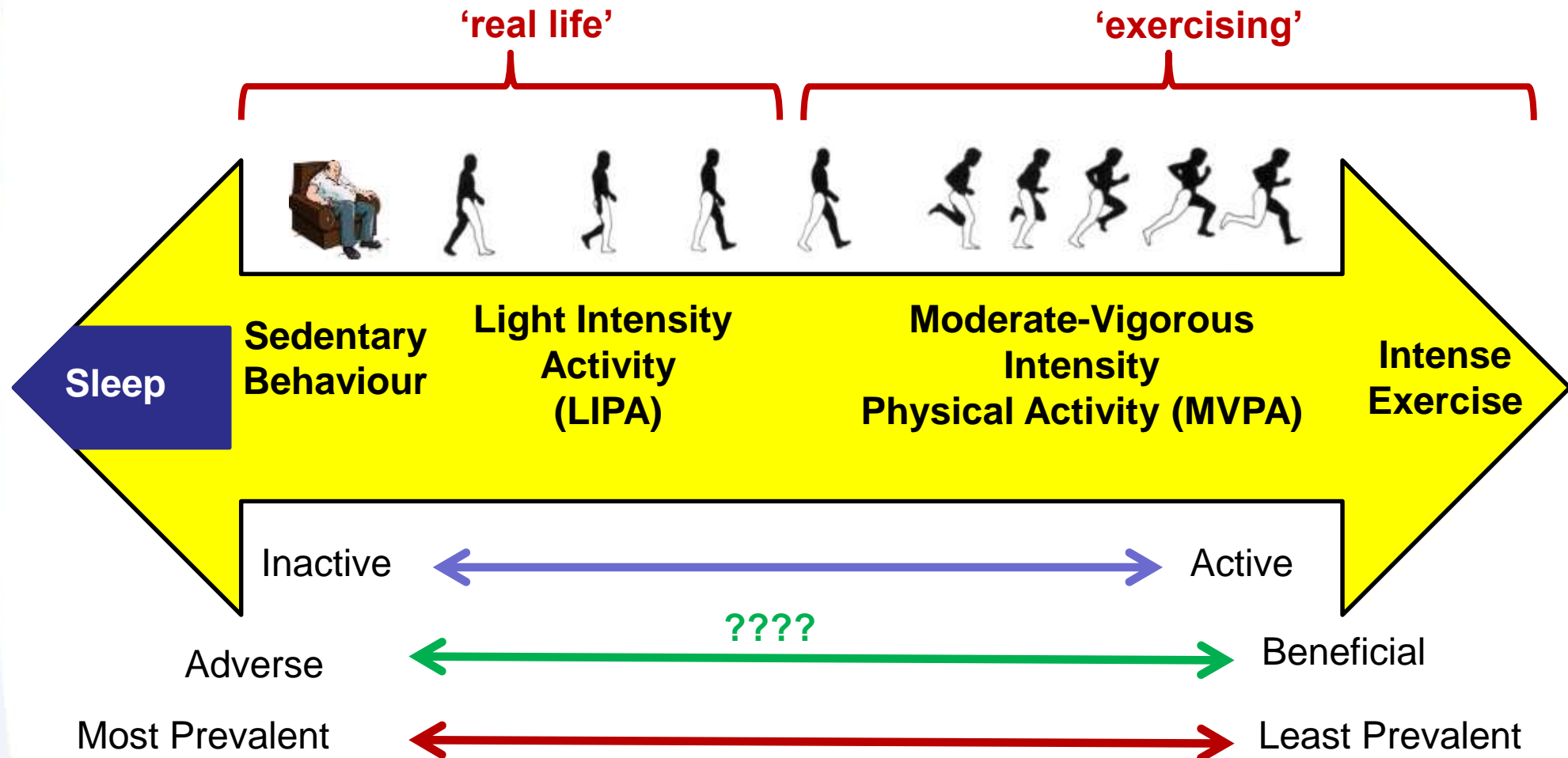


Now and the future – a population challenge

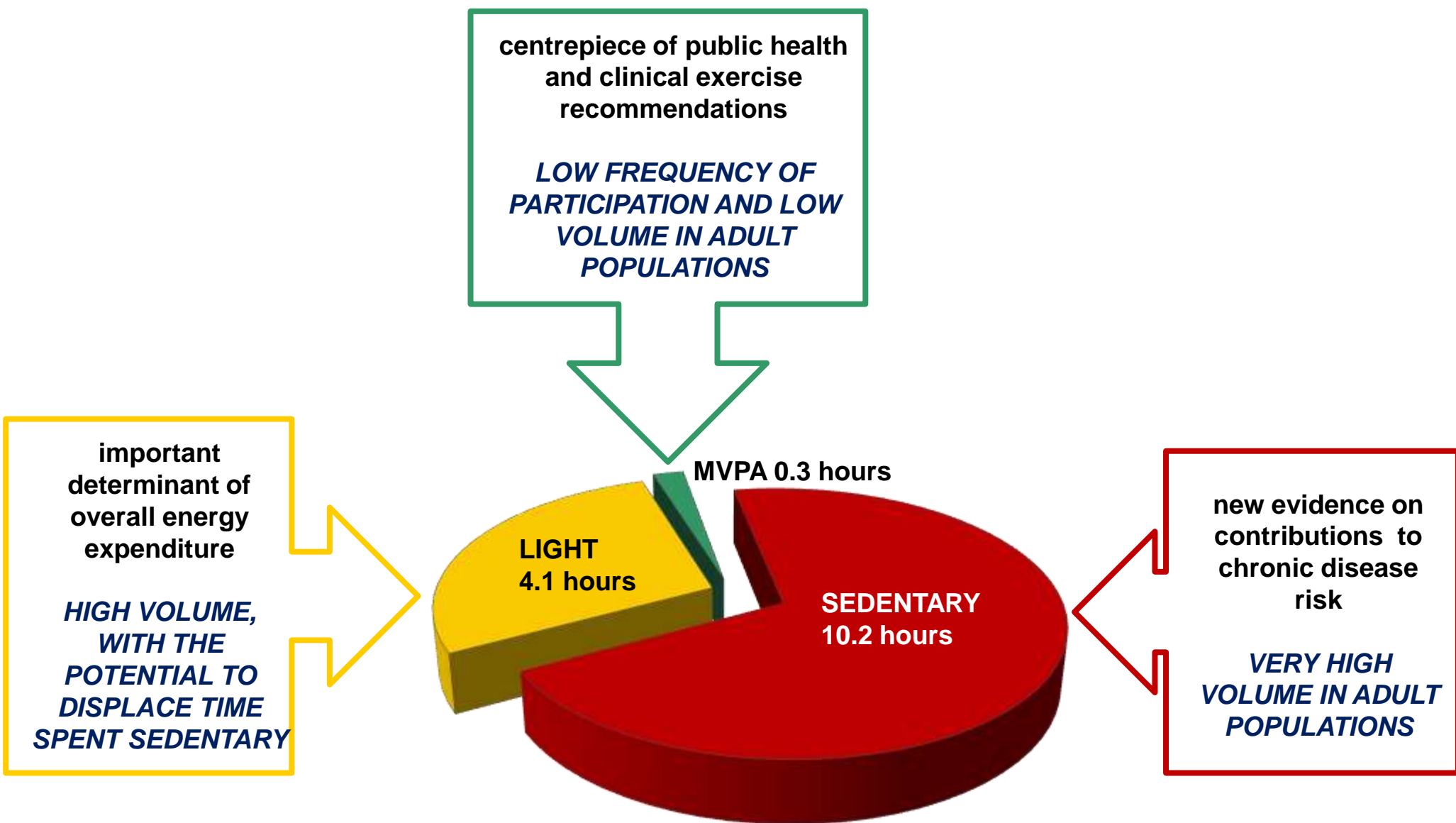


Source: Ng & Popkin (2012) *Obesity Rev*: 13: 659-680

The physical activity spectrum



Adapted from: Tremblay, M.S., Colley, R., Saunders, T.J., Healy, G.N. and Owen, N. (2010). Physiological and health implications of a sedentary lifestyle. *Applied Physiology, Nutrition and Metabolism*, 35, 725-740.



Owen N, Healy G, Dunstan D. 'Too much sitting: health risks of sedentary behaviour and opportunities for change'. *Research Digest*. 2012; 13(3): 2-11.

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Where to next?

Too much sitting – not new



Bernadino Rammazzini

1633-1714

De Morbis Artificum Diatriba

“Disease of Workers”



*Bernardino Ramazzini
the founder
of Occupational Medicine*

“...those who sit at their work and are therefore called 'chair workers,' such as cobblers and tailors, suffer from their own particular diseases ... these workers ... suffer from general ill-health and an excessive accumulation of unwholesome humours caused by their sedentary life”

“All sedentary workers ... suffer from the itch, are a bad colour, and in poor condition ... for when the body is not kept moving the blood becomes tainted, its waste matter lodges in the skin, and the condition of the whole body deteriorates”



**SITTING IS
THE NEW
SMOKING.**

M^OVE 1

SITTING IS THE NEW ENEMY



M^OVE 1

FACEBOOK.COM/MOVE1HOUR



M^OVE 1

ONE HOUR OF ACTIVITY EVERY DAY MAKES THE DIFFERENCE OF A LIFETIME.



Heart
Foundation

Action area 5 – Prolonged sitting (sedentary behaviour)

Promote opportunities and approaches
to reduce prolonged sitting

Australia's Physical Activity and Sedentary Behaviour Guidelines for Adults (18–64 years)

2014

PHYSICAL ACTIVITY

- Doing any physical activity is better than doing none. If you currently do no physical activity, start by doing some, and gradually build up to the recommended amount.
- Be active on most, preferably all, days every week.
- Accumulate 150 to 300 minutes (2 ½ to 5 hours) of moderate intensity physical activity or 75 to 150 minutes (1 ¼ to 2 ½ hours) of vigorous intensity physical activity, or an equivalent combination of both moderate and vigorous activities, each week.
- Do muscle strengthening activities on at least 2 days each week.

SEDENTARY BEHAVIOUR

- Minimise the amount of time spent in prolonged sitting.
- Break up long periods of sitting as often as possible.



AusDiab1 (1999) TV viewing time



Please estimate the total time during the last week that you spent watching TV or videos. This is when it was the main activity that you were doing; for example you would not include time when the television was switched on and you were preparing a meal.

Monday to Friday

minutes

hours

Saturday and Sunday

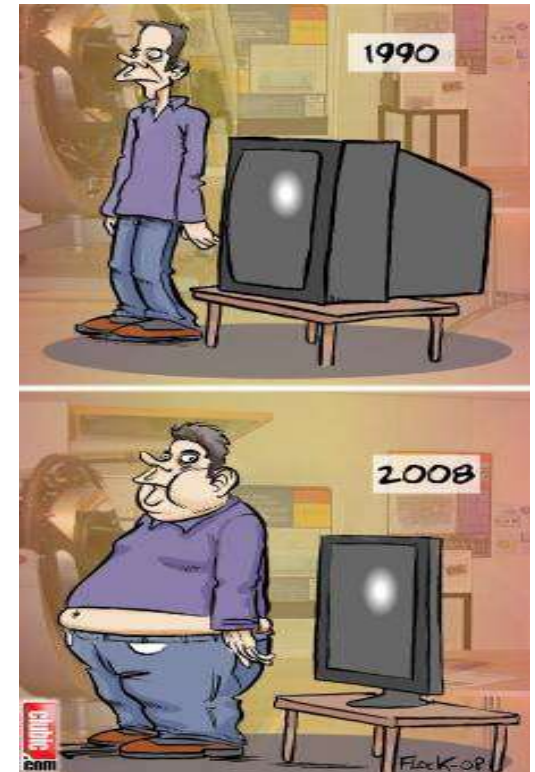
minutes

hours



High television viewing time (2 to 4+ hrs/day) is detrimentally associated with biomarkers and health outcomes, independent of leisure-time physical activity

- Cardiovascular disease risk¹
- Overweight ^{2,3}
- Diabetes³
- Metabolic Syndrome^{4,5}
- Abnormal glucose metabolism⁶ and other biomarkers of cardio-metabolic health ⁷
- Cancer ^{8,9}

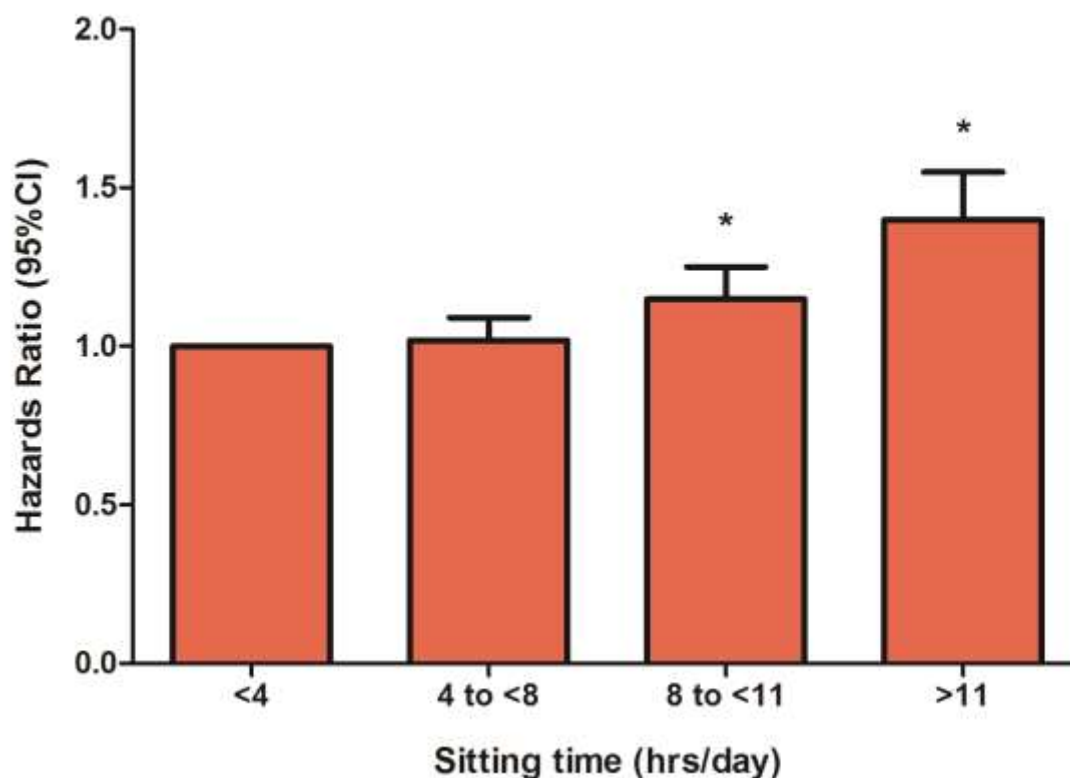


¹Jakes et al., *E J Clin Nu* 2003; ²Ching et al., *AJPH* 1996; ³Hu et al., *JAMA* 2003 ⁴Dunstan et al., *Diabetologia* 2005 ; ⁵Bertrais et al., *Obesity Research* 2005; ⁶Dunstan et al., *Diabetes Care* 2004; ⁷ Healy et al., *MSSE* 2008 ; ⁸ Patel et al., *A J Epi* 2006; ⁹Howard et al., *Cancer Causes and Control* 2008

Overall sitting time and all-cause mortality risk in 222,497 Australian adults



Sitting Time & All-cause Mortality



Adjusted for:
age, sex,
education, marital
status, urban/rural
residence,
physical activity,
BMI, smoking



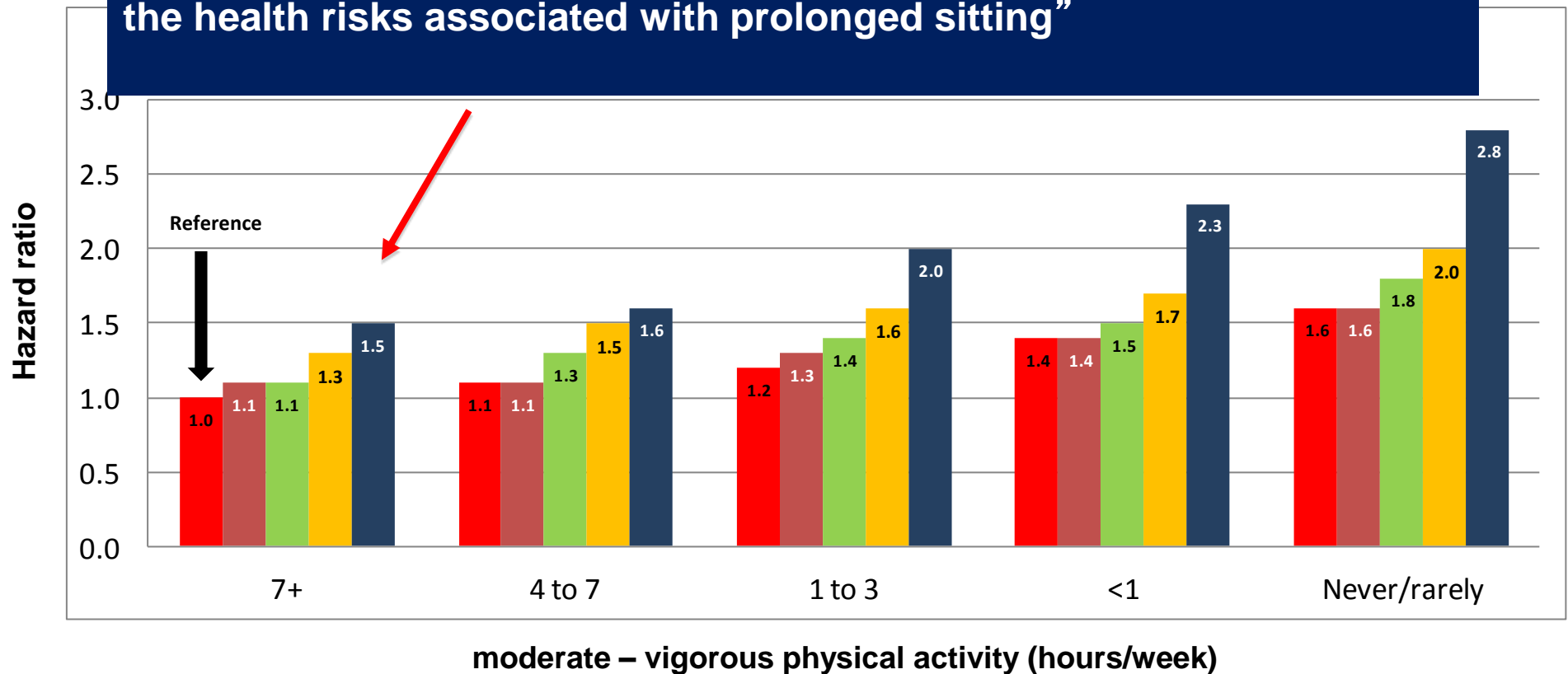
Adrian Bauman

TV viewing time and all-cause mortality

Source: C Matthews *et al.* *Am J Clin Nutr* 2012



“....participation in leisure-time physical activity does not fully mitigate the health risks associated with prolonged sitting”



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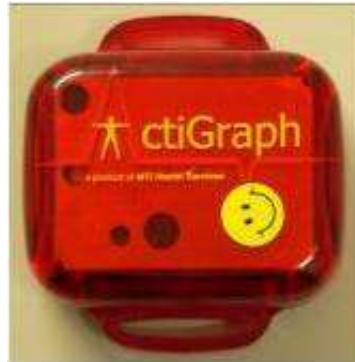
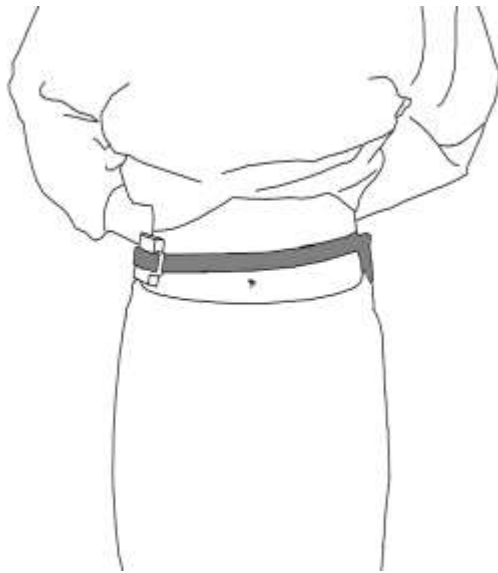
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Where to next?

Device-based measurement of movement and posture

Accelerometer



'market dominator' from the output of which (counts of less than 100 pm) we infer 'sedentary' time

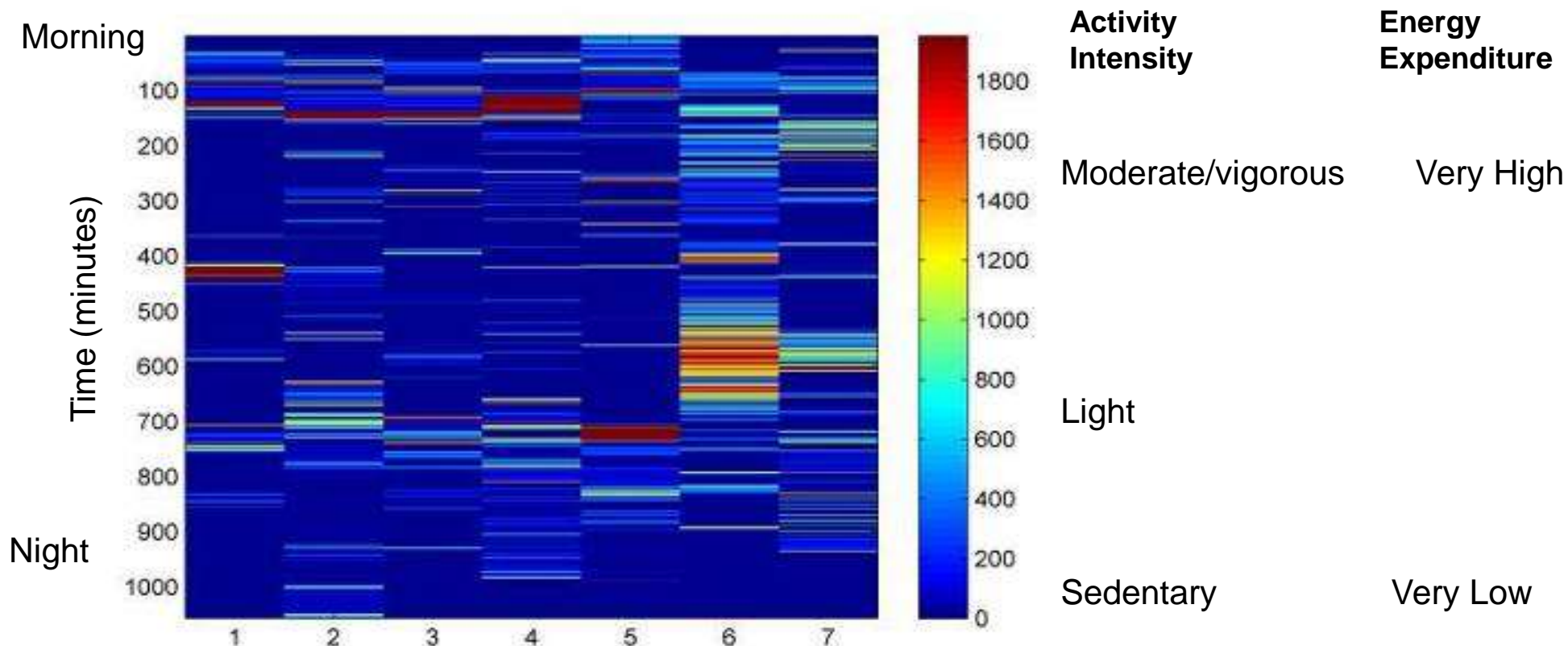
Inclinometer



from the output of which we can derive posture-based indices of 'sitting' time

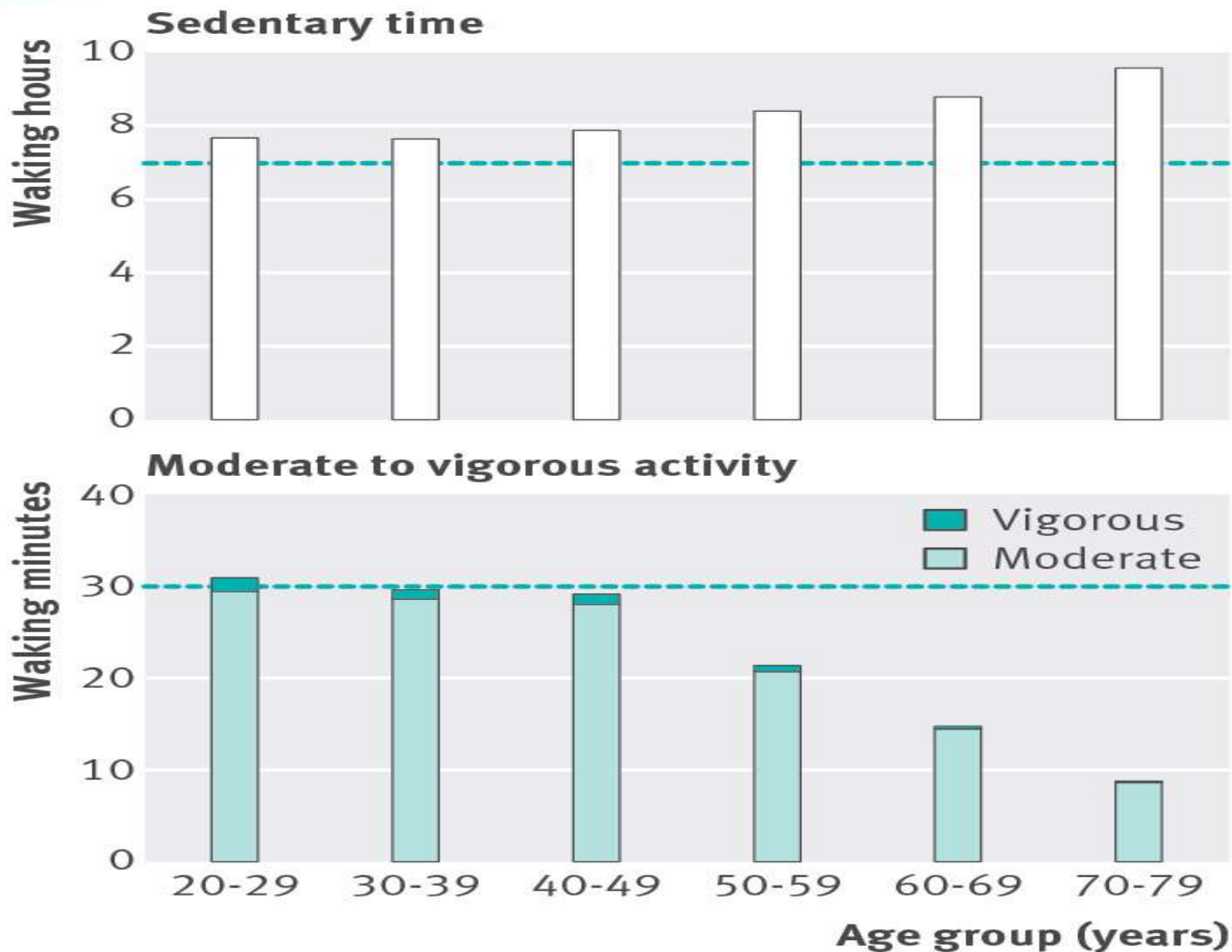
We can be 'active', but also highly sedentary

the 'active' couch potato



mean mod-to-vigorous time = **31 mins/day**

% waking hours spent sedentary = **71%**



Sparling PB, Howard BJ, Dunstan DW, Owen N. Recommendations for physical activity in older adults. *British Medical Journal*. 2015; 350: h100.

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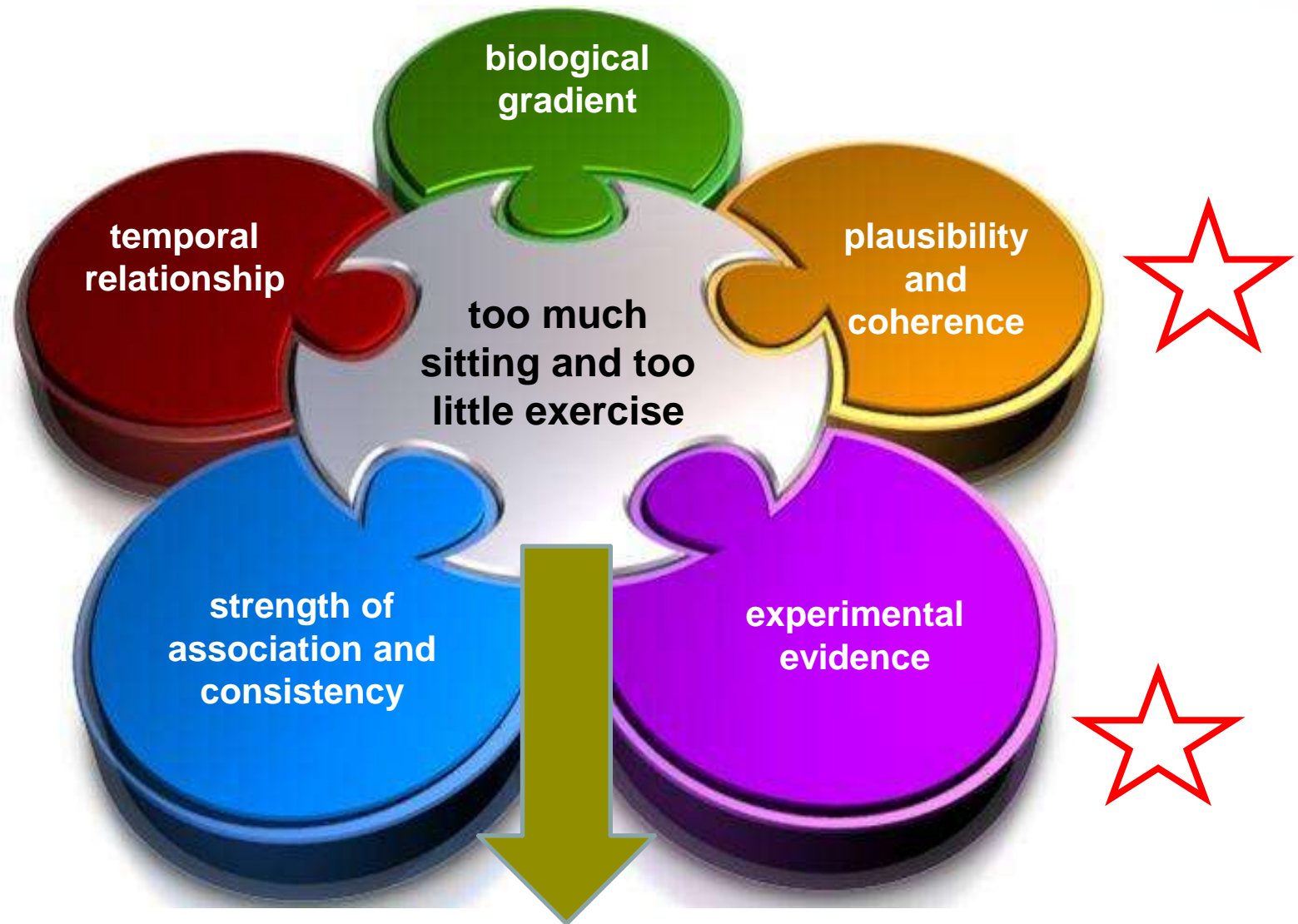
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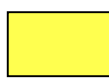
Where to next?



Source: Bradford Hill
1965 *Proc of Royal
Soc Med* 58: 295-300

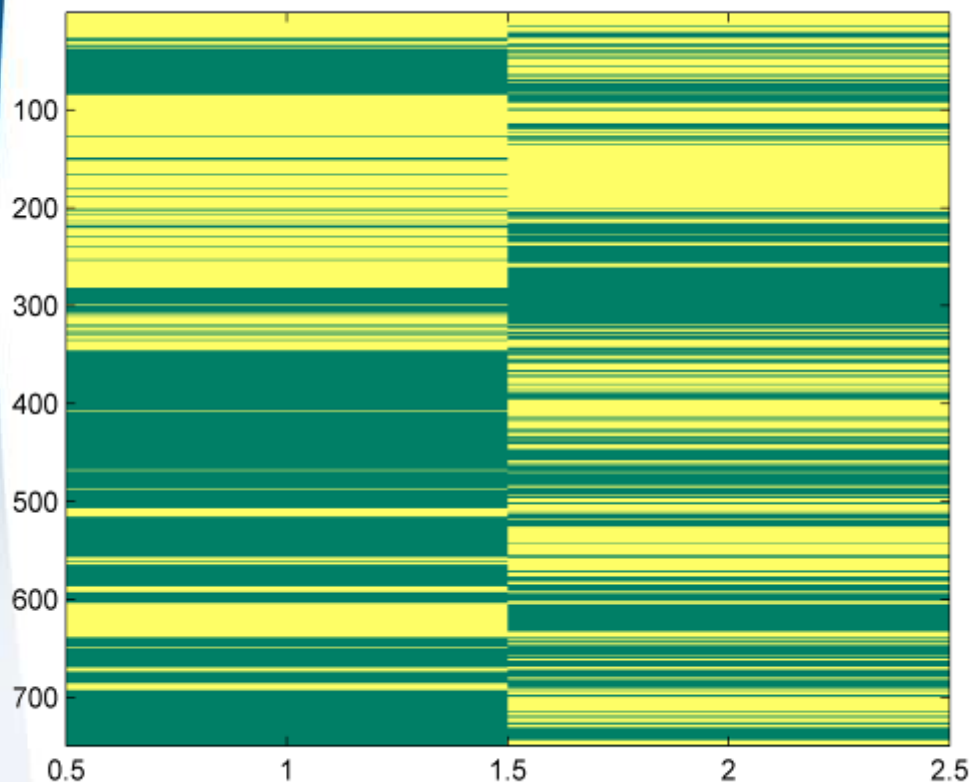
Patterns of sedentary and active time are important

 Sedentary
CPM < 100

 Not sedentary
CPM 100+

‘Prolonger’

‘Breaker’

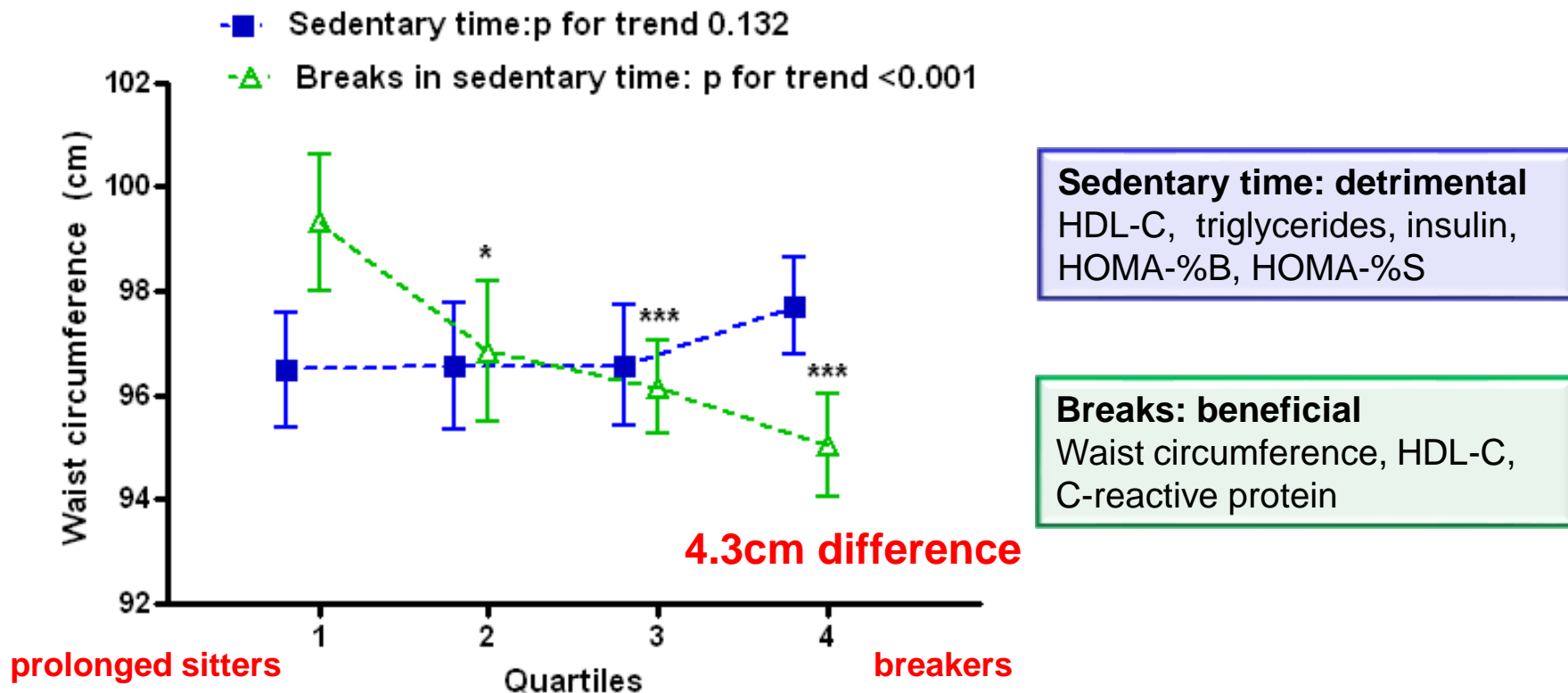


These two people have exactly the same sedentary time

More breaks from sitting time associated with lower average waist circumference, BMI, triglycerides, and 2-hr plasma glucose

Healy, G.N., Dunstan, D.W., Salmon, J., Cerin, E., Shaw, J.E., Zimmet, P.Z. and Owen, N. (2008). Breaks in sedentary time: Beneficial associations with metabolic risk. *Diabetes Care*, 31, 661-666.

Sedentary time & breaks in sedentary time: NHANES 2003-2006



Adjusted for age, sex, race/ethnicity, moderate-vigorous intensity activity + other potential confounders

Breaks in sedentary time additionally adjusted for total sedentary time

Healy G.N., Matthews, C.E., Dunstan, D.W., Winkler, E.A.H., Owen, N. (2011). Sedentary time and cardio-metabolic biomarkers in US adults: NHANES 2003-06. *European Heart Journal*, 32, 590-597

Breaking Up Prolonged Sitting Reduces Postprandial Glucose and Insulin Responses

DAVID W. DUNSTAN, PHD^{1,2,3,4,5}
BRONWYN A. KINGWELL, PHD¹
ROBYN LARSEN, PHD¹
GENEVIEVE N. HEALY, PHD^{1,3}
ESTER CERIN, PHD⁶
MARC T. HAMILTON, PHD⁷

JONATHAN E. SHAW, MD^{1,2}
DAVID A. BERTOVIĆ, FRACP¹
PAUL Z. ZIMMET, MD^{1,2}
JO SALMON, PHD⁴
NEVILLE OWEN, PHD^{1,3}



PARTICIPANTS (n=19)

Age: 45-65 years

Overweight/obese: BMI > 25 ≤ 45 kg/m²

Study Design

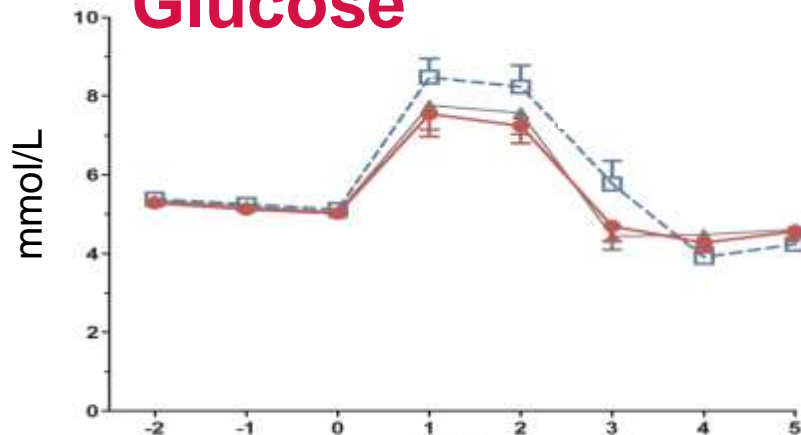
Randomised Cross-Over Trial

Acute (1 day) exposure – 7 hours

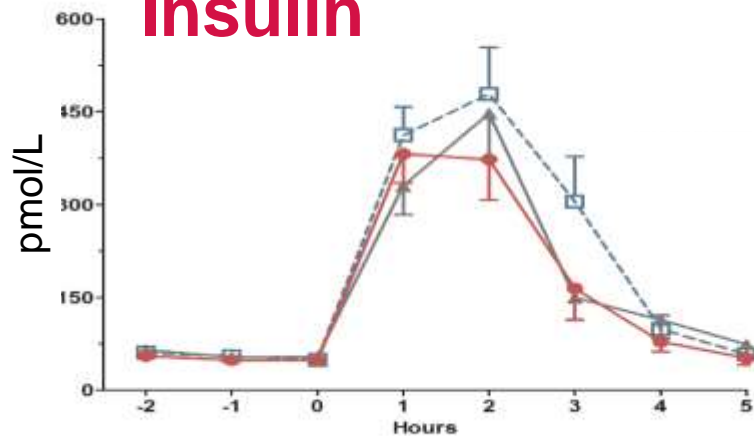
1. Prolonged sitting
2. Sitting + light walking (2 min every 20 min)
3. Sitting + moderate walking (2min/20 min)

Breaking Up Prolonged Sitting Reduces Postprandial Glucose and Insulin Responses

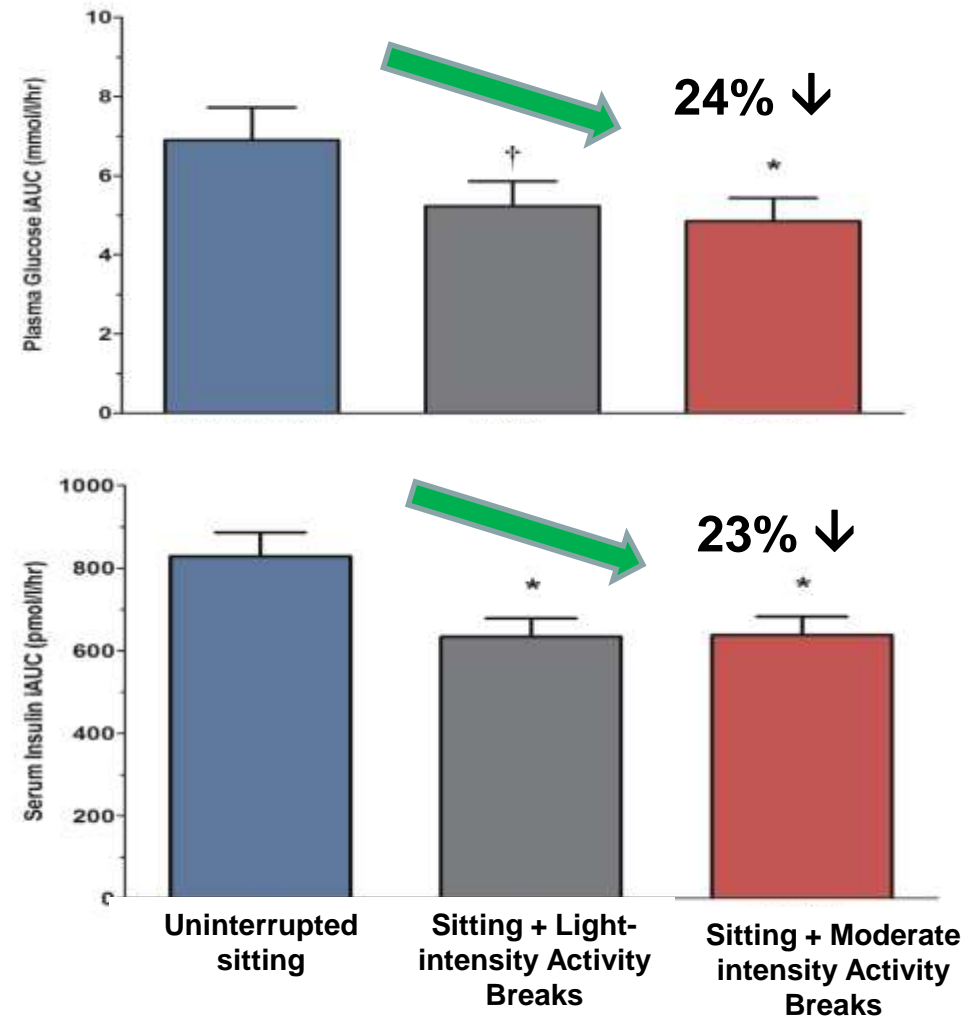
Glucose



Insulin



- Uninterrupted Sitting
- ▲ Sitting + Light-intensity Activity Breaks
- Sitting + Moderate-intensity Activity Breaks





NATIONAL
GET FIT
DON'T SIT DAY

.....
GET UP & MOVE!
.....

MAY 6, 2015

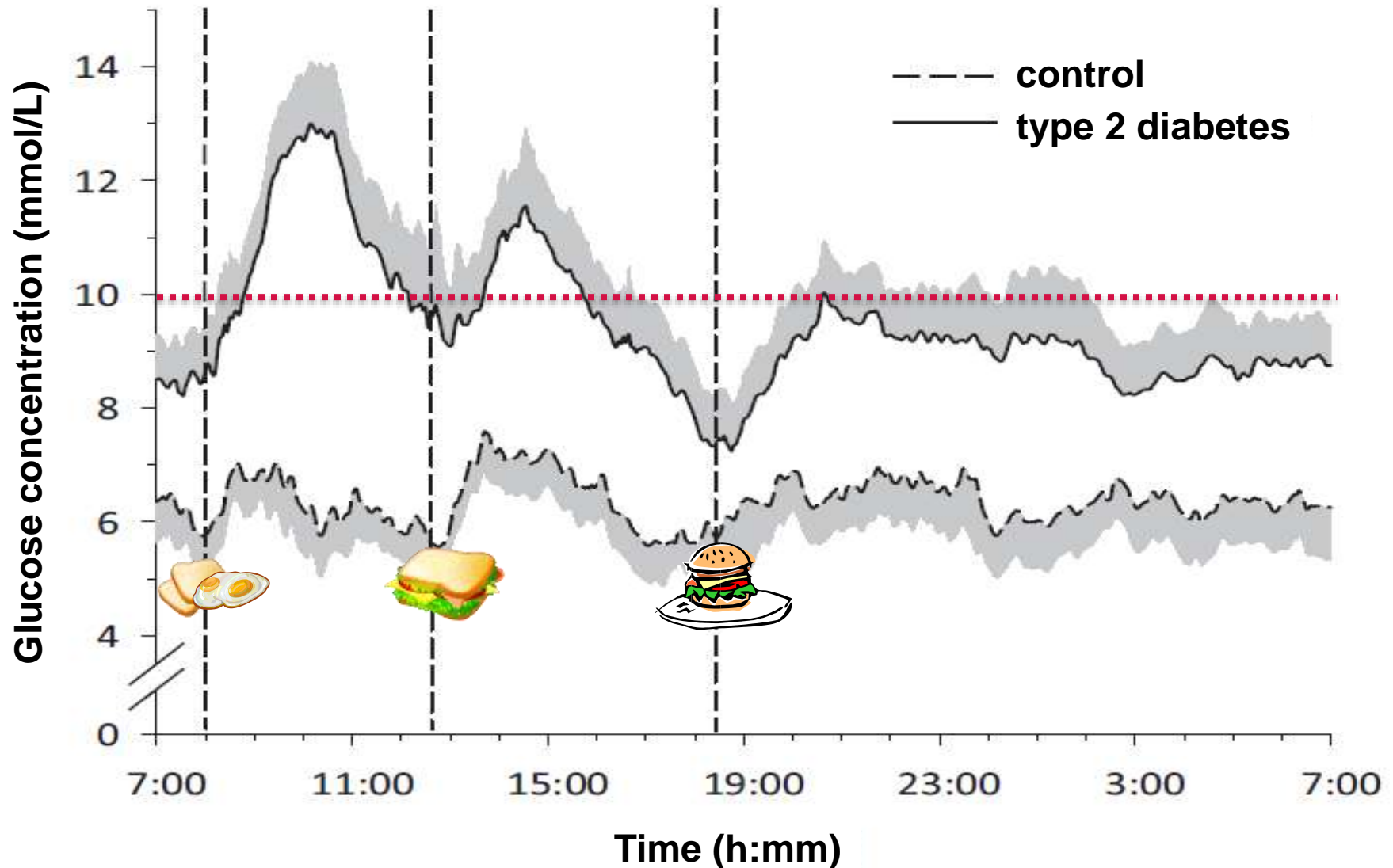
 American Diabetes Association

REsistance and WAlking breaks in Reducing DIabetes

Aim

Investigate the acute (1-day) effects of a single bout of uninterrupted sitting on postprandial blood glucose and 22-h glycaemia in patients with T2D with and without intermittent bouts of light-intensity walking or simple resistance activities.

High prevalence of postprandial hyperglycemia in T2D



Post-prandial dysmetabolism: hyperglycemia and hyperlipidemia)

Independent risk factor for future cardiovascular events¹

Exaggerated post-prandial spikes in glucose and lipids

→ oxidative stress → endothelial dysfunction

→ atherosclerosis^{2,3}

When repeated multiple times throughout the day:

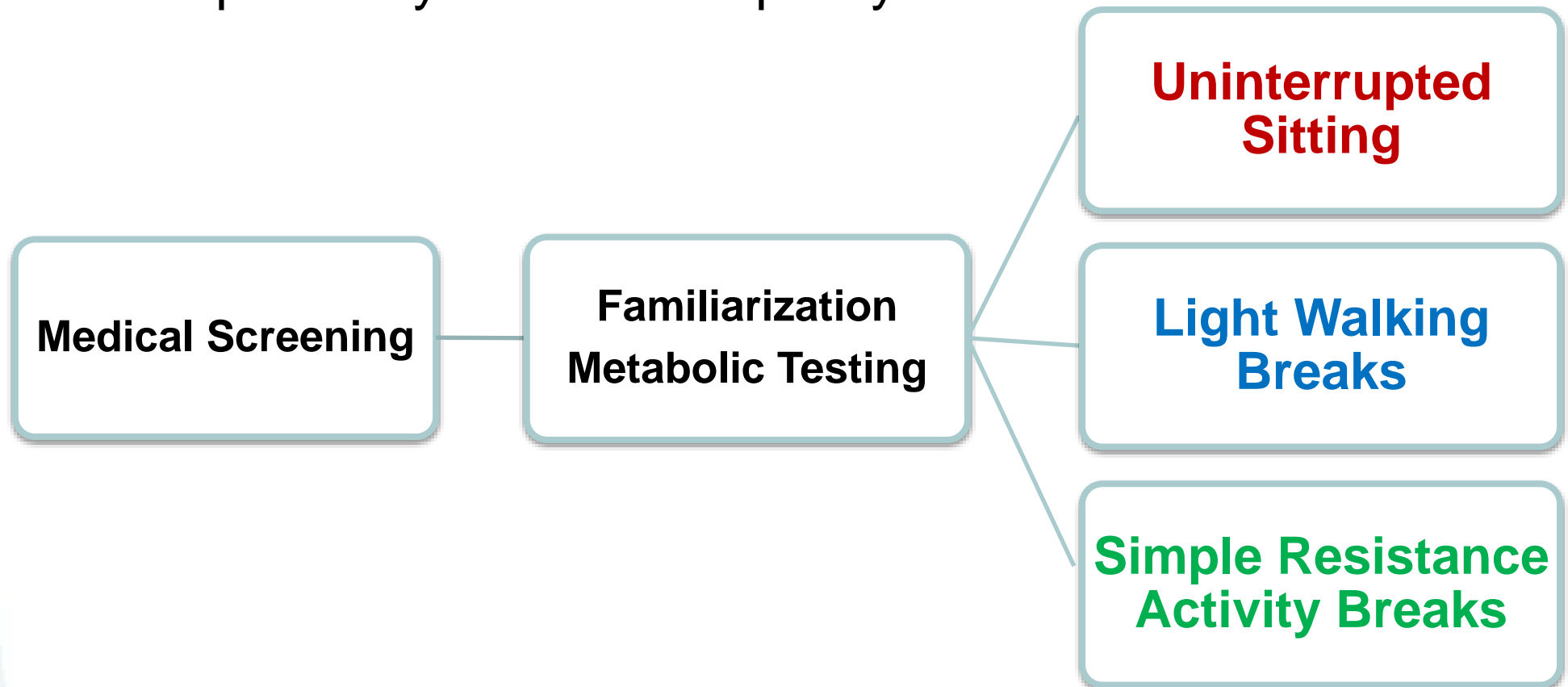
→ environment conducive to CVD risk factors and CHD^{1,3}

¹ O'Keefe JH & Bell DSH 2008 *Am J Cardiol* ² Ceriello A 2000 *Diabetes Metab Res Rev*

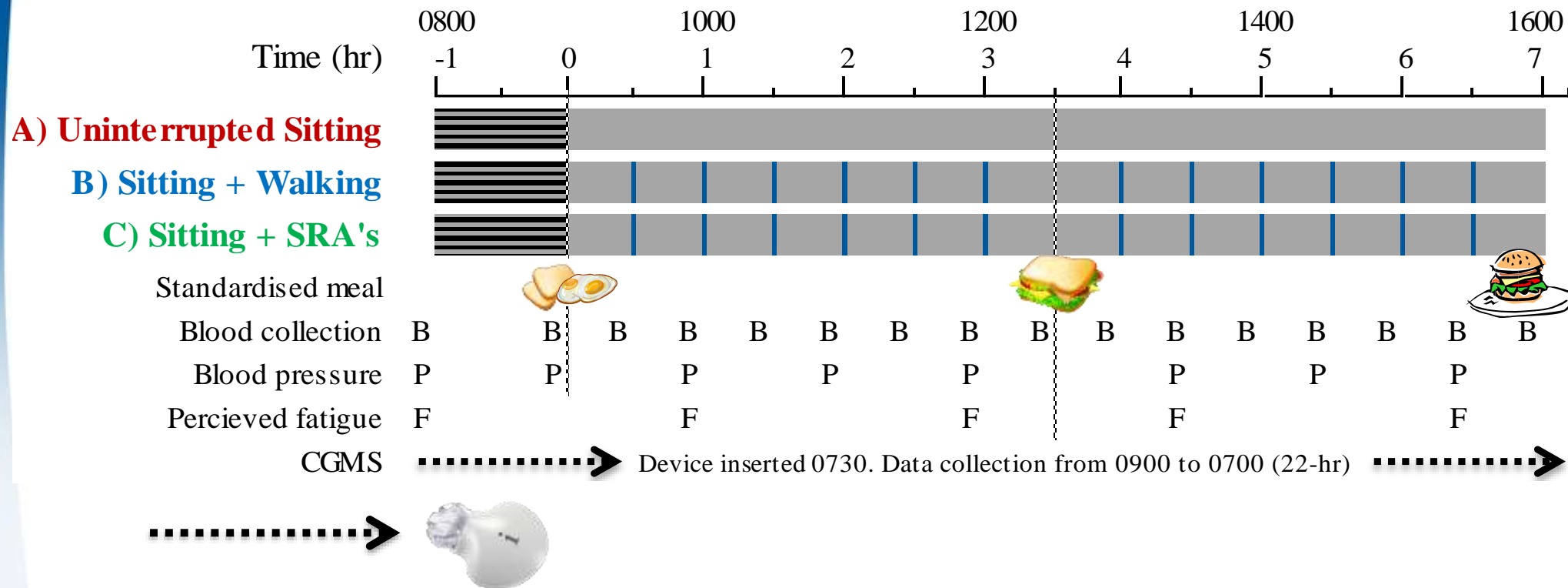
³ Heine RJ *et al.* 2004 *Diab Med*

Randomised, three period, cross-over trial

- ~1 week washout
- Diet, physical activity & medications standardised
- Sleep latency / duration / quality diaries



Experimental days



Meet Judy



- Has Type 2 Diabetes
 - Works for computer software company
 - Drives to work, watches TV at night
 - Physically inactive – ‘too busy’, ‘I need to do more’
 - Obese (BMI: 31)
 - Struggles to control blood sugar; HbA1c: 7.3
 - Taking metformin
 - Seeing a dietitian
 - Current physical activity recommendations for T2D:
 - Aerobic exercise (150min/wk spread throughout the week) bouts ≥ 10 min
 - Resistance exercise 3 x/wk (+ balance & flexibility exercises)

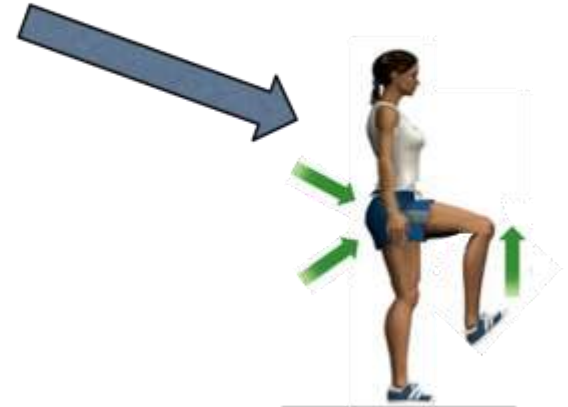
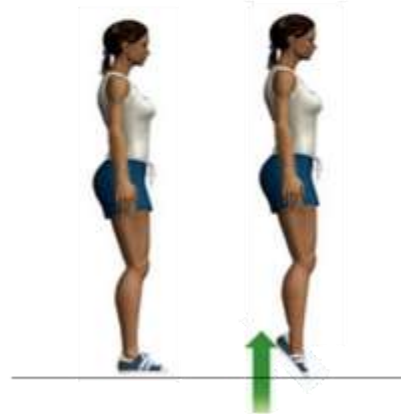
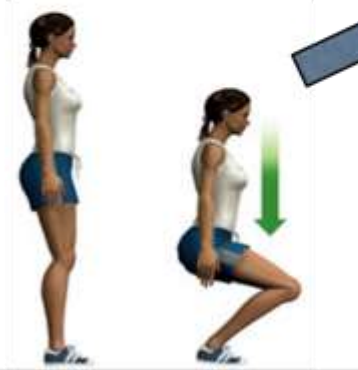


*Light intensity walking:
3 min @ 3.2km/hr every
30 min*

Simple Resistance Activities – SRA's

3 min SRA breaks every 30 min (total 12 occasions – accumulating 36 min)

Body weight calf raises (20 s)



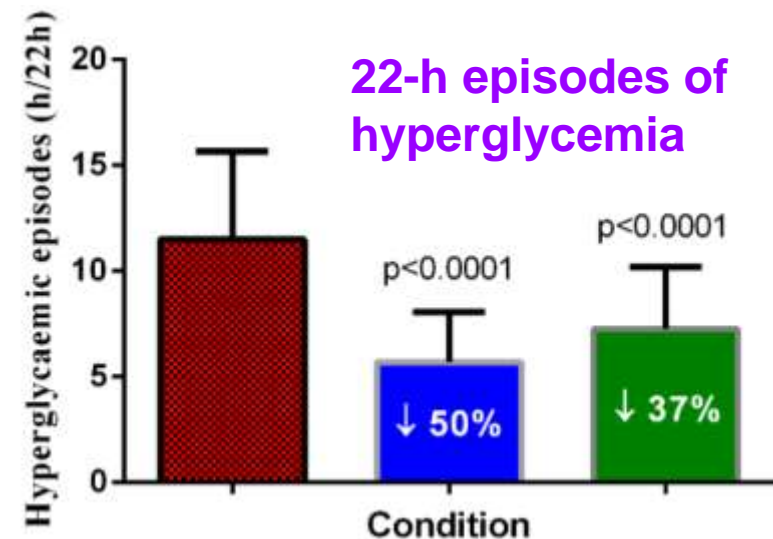
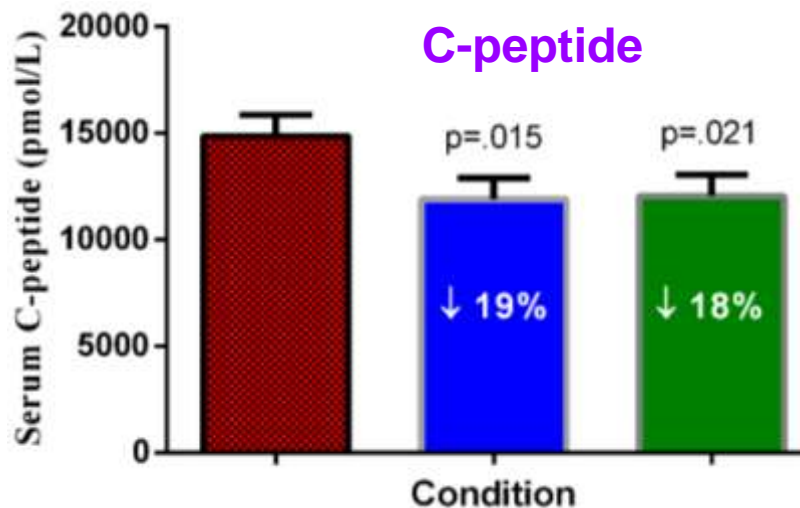
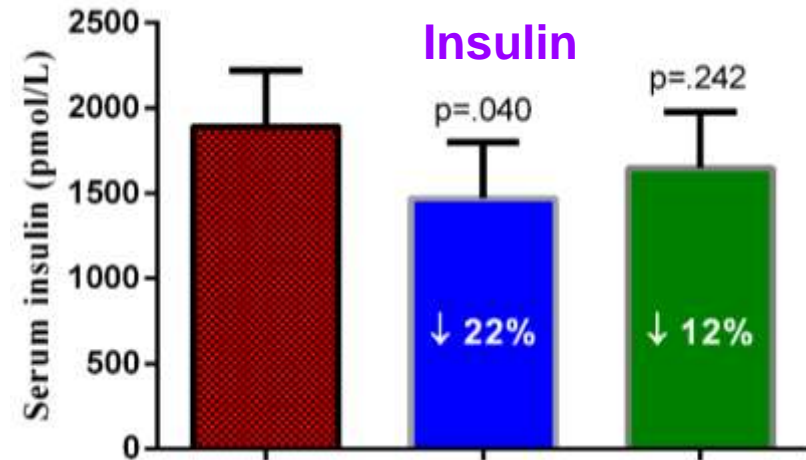
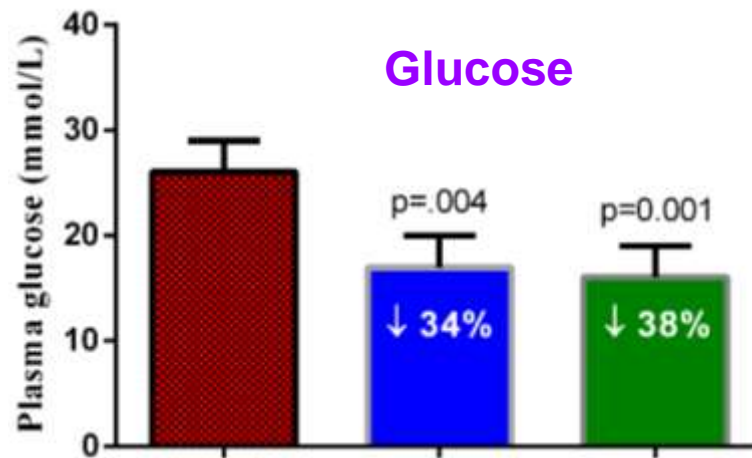
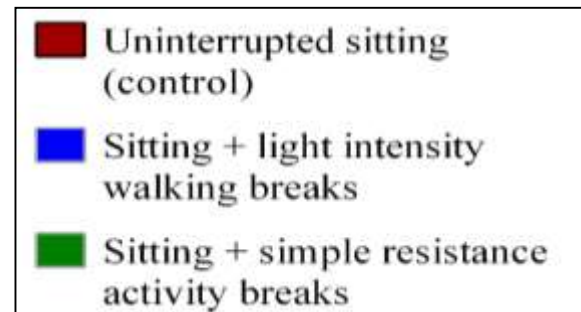
Body weight half-squats (20 s)

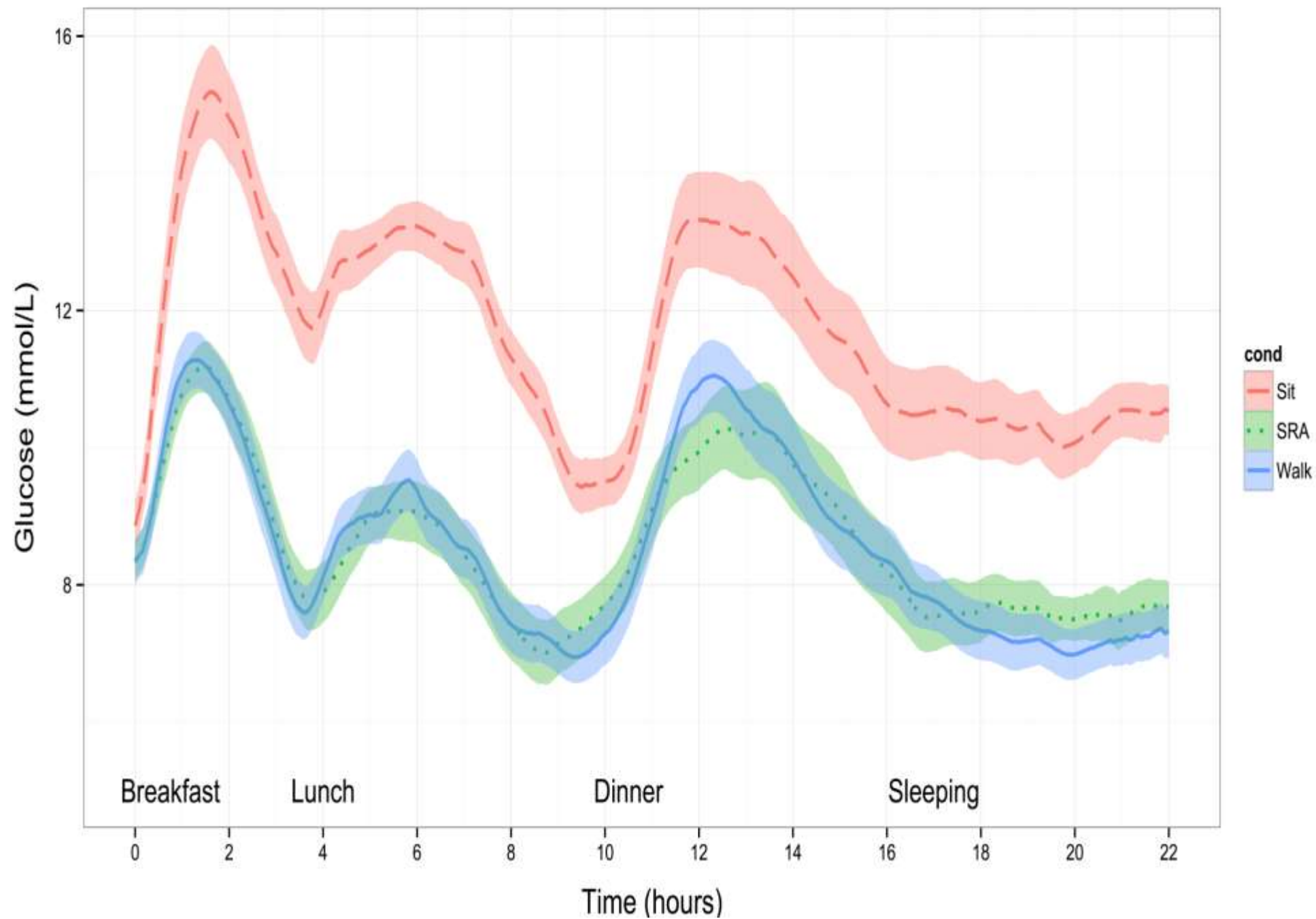
X 3

Standing gluteal activations in-between single leg knee raises (20 s)

Preliminary findings

Attenuated 7-h postprandial responses & episodes of hyperglycemia over 22-h (n = 6).





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Where to next?

Centre of Research Excellence on Sitting Time and Chronic Disease Prevention

Theme 1: Measurement



Healy



Trost

Theme 2 : Mechanisms



Kingwell



Dunstan

Theme 3: Interventions



Salmon



Eakin



Winkler



Lambert



Timperio

Plus International and National Associate Investigators

Baker IDI: Experimental Program



IDLE Breaks (brief walking breaks at moderate and light intensity: acute responses)

ABLE Breaks (brief walking at moderate and light intensity: chronic responses)

SOS (standing-only breaks)

Stand Up Victoria (field experiment with sit-to-stand workstations and multi-level interventions)

Studies of vascular, autonomic and cognitive responses

Studies with specific groups: (adults with diabetes, post-menopausal women)

Too much sitting and too little exercise: where to next?

1. What mechanisms result in too much sitting being a major health risk?
2. Experimental evidence is crucial: What is most relevant to change? Total time? Sit-to-stand transitions? Up time? LIPA time? Prolonged sitting bouts? *Dose-response*?
3. Is it feasible and beneficial for people of different ages to reduce, break up or otherwise change sitting time?

With findings on 1, 2 and 3 from laboratory and field-based experimental studies, we may have greater caution and/or added impetus, to address 4, 5, 6 and 7

Too much sitting and too little exercise: where to next?

4. Identify how the settings in which children, adolescents, adults and older people do a great deal of sitting – home environment; transport; residential care; community – exert their influences
5. What are ‘the points of traction’ for reducing prolonged sitting that are most effective and that will do no harm?
6. How to further integrate a focus on sitting into physical activity guidelines and policy?
7. How best to communicate and engage different groups in different contexts in relation to prolonged sitting and health?

A prudent 'bottom line'

Create opportunities within our waking hours to ***limit sitting time***

Avoid prolonged sitting periods - break up sitting time on a regular basis (“***Stand Up, Sit Less, Move More, More Often***”)

The above messages are ***in addition to*** (and not an alternative to) engaging in ***aerobic and strength (and flexibility and balance) developing physical activities***



Chromium comfort

THE END



Mauruuru e koe

Ecological Model of Four Domains of Sedentary Behavior

The diagram illustrates the ecological model of sedentary behavior, showing concentric circles representing different domains of influence, from the individual level to the policy level.

Central Domain: Intrapersonal

- Demographics
- Biological
- Psychological
- Family Situation

Second Domain: Perceived Environment

- Leisure Time:** Negative perceptions of "active" environments: unsafe, uncomfortable, unattractive, inconvenient.
- Household:** Comfort, convenience of labor saving devices, attractiveness of sedentary entertainment.
- Occupation:** Cues for sitting, purpose of furniture/desk.
- Transport:** negative perceptions of active transport facilities; positive perception of motorized facilities.

Third Domain: Sedentary Behavior Domains

- Neighborhood:** - poor ped/bike facilities, -aesthetics, -traffic safety.
- Recreation Environment:** Seating in Parks, Park design to promote sitting, Screen-based entertain; movies, game arcades, Sport spectatorship.
- Home Environment:** Electronic entertainment; passive/active, Remote controls, Labor-saving devices, Furniture for sitting/reclining.
- Workplace Environment:** Furniture designed for sitting, Neighborhood walkability, Parking, Transit access, Building design, Stair design, Ped/Bike Facilities.
- School Environment:** Neighborhood walkability, Ped/bike facilities, Facilities, PE program, Walk to School program.

Fourth Domain: Behavior Settings: Access & Characteristics

- Neighborhood:** - walkability, - ped/bike facilities, - parking, -transit, -traffic.
- Info promoting SB during transport:** - safety signage, - radio ads & news, - billboards (TV, movies, sports).
- Requirements for seated work:** OHS codes, Rules for breaks, Zoning codes, Building codes, Parking regulations, Transportation investments.
- Requirements for sitting PE & recess policies:** Facility & policy access policies, Safe Routes to School funding.

Fifth Domain: Policy Environment

- Information Environment:** Media regulations, Health sector policies, Business practices.
- Social Cultural Environment:** Advocacy by individuals & organizations.
- Natural Environment:** Weather, Topography, Air quality.
- Transport policies:** Energy policies.
- Other factors:** Zoning codes, Development Regulations (sidewalk requirements), Transport investments, Traffic demand management, Parking regulations, Developer incentives.

07-20-05

Owen, N., Sugiyama, T., Eakin, E.G., Gardiner, P.A., Tremblay, M.S. and Sallis JF. (2011). Adults' sedentary behavior: Determinants and interventions. *American Journal of Preventive Medicine*, 41, 189-196.

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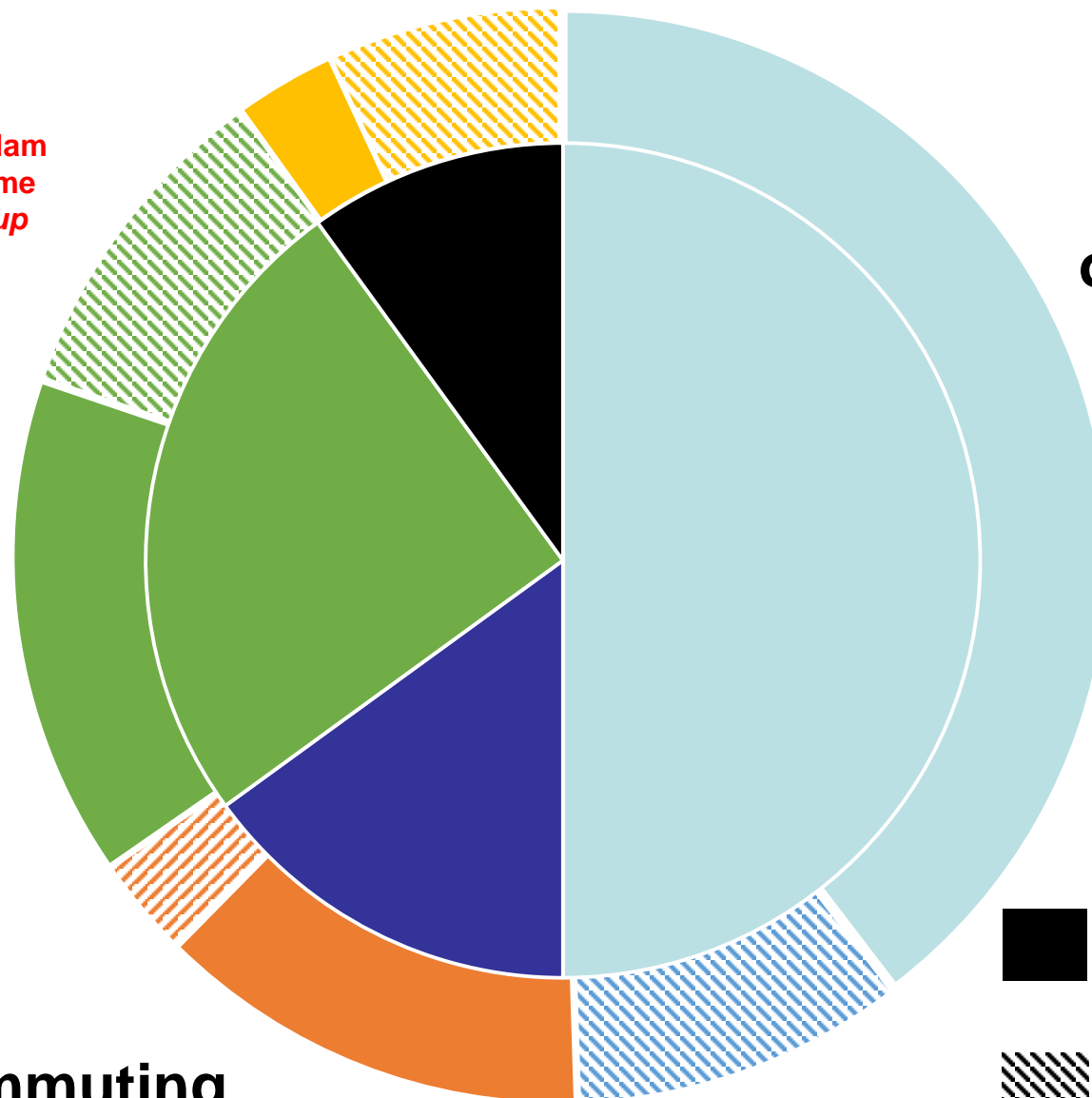
community

occupational

Kazi, Duncan, Clemes, Haslam
(2014). A survey of sitting time
among UK employees. *Occup
Med (Lond)* 64, 497-502

domestic

commuting



**non-discretionary
sitting time**

**discretionary
sitting time**



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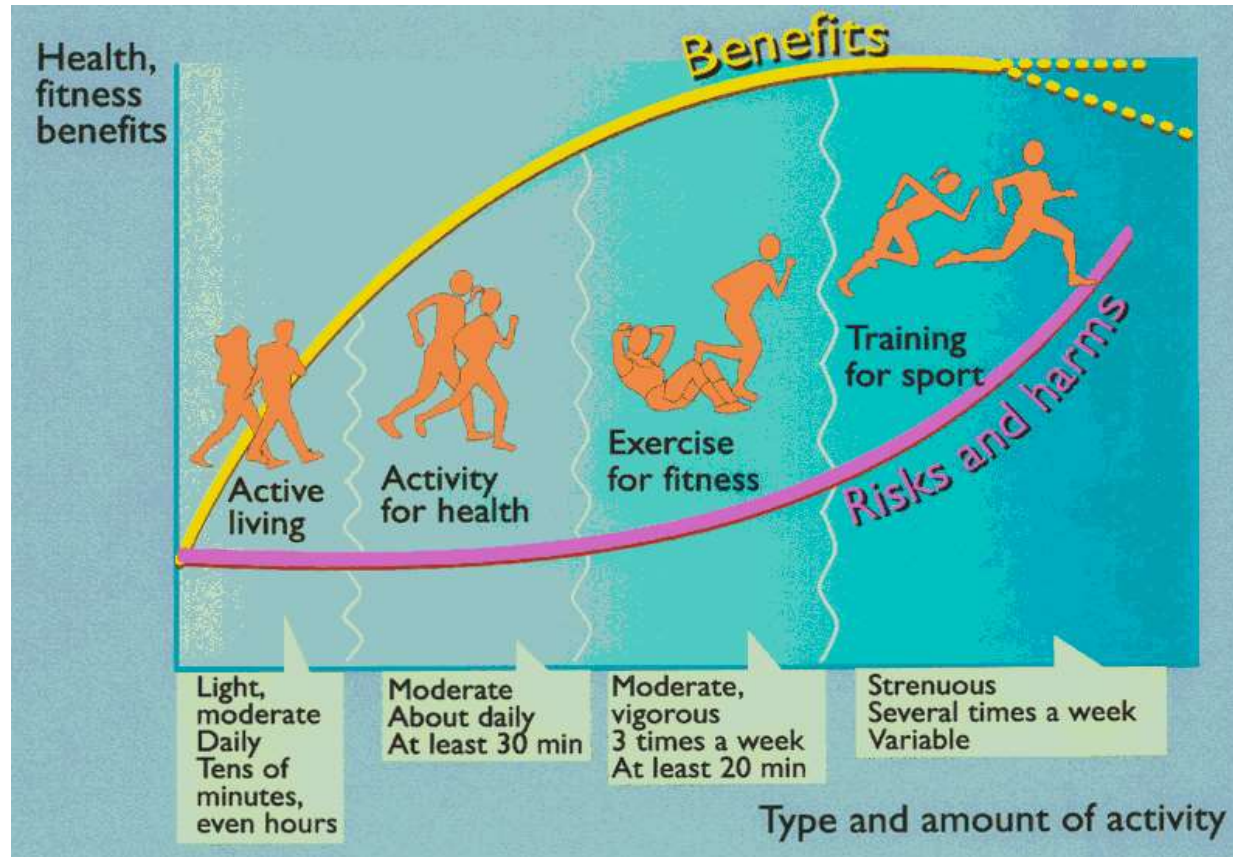


Dilbert (2013)

(thanks to Scott Adams)



however, the science can be a bit more complicated



High Intensity Training



Too Much Sitting



average
calories
per serving
reduced

22%

